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GB 0890416 A
JP 080188200 A
US 5009374 A

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Other: ONLINE: EPODOC, JAPIO, WPI

(54) Abstract Title

Destroying or landing by parachute detached aircraft parts and aircraft wing construction enveloping an engine

(57) To assist with ground protection from parts detached from an aircraft during flight which are not intended to be detached (eg, engine 18, wing or landing gear), the aircraft has sensors to detect if a part has become detached. Part detachment sensing may comprise measuring the distance between a transponder pair 19a, 19b, which may be RF tags. The pair 19a, 19b may use coded signals, and may use data from a global positioning system (GPS) and/or altimeter of the aircraft. A detached part may be slowed by a parachute, or destroyed by a pyrotechnic device if falling at a terminal velocity or if a GPS signal for the part is within a "no go" exclusion zone. Alternatively the sensors may measure stress or load, or be provided at a plurality of potential failure points.

A wing construction is also disclosed (figs 4-6) in which an engine is enveloped by a bifurcated structure comprising two parts welded together.

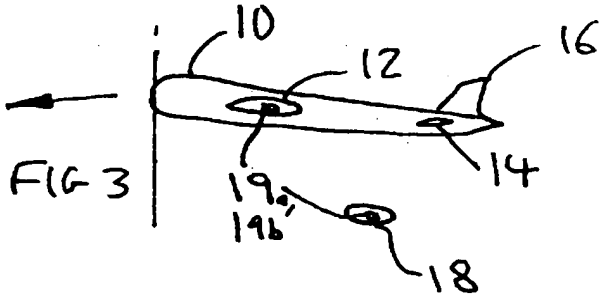

FIG 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1995

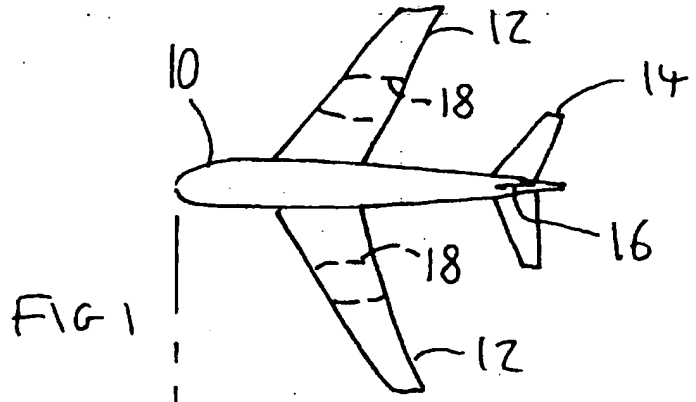

FIG 1

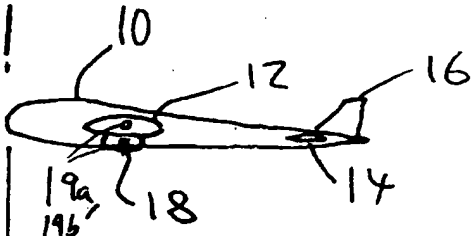

FIG 2

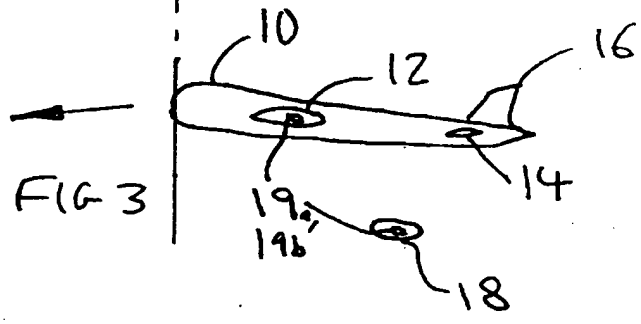

FIG 3

FIG 4

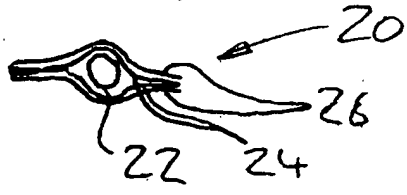

FIG 5

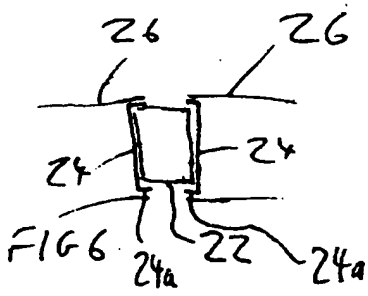

FIG 6

GROUND PROTECTION FROM AIRCRAFT

Due to progressive loosening of fastening bolts caused by e.g. inflight stresses, or tampering, an engine can detach from an aircraft wing and fall to the ground, possibly also causing the aircraft to destabilise.In flight stresses can cause a part to simply shear off.

The out-of-control aircraft and the detached engine can cause enormous damage if they strike the ground below. The out-of-control aircraft and the detached engine move at different speeds to normal and along different vectors (e. g. substantially vertically in the case of the aircraft and vertically in the case of the engine) to the usual.

One aim of the invention is to provide a device which prevents damage due to part (or whole aircraft falling to the ground.

According to a first aspect of the invention there is provided an aircraft comprising a part not intended to detach from the aircraft during flight such as an engine, the aircraft also comprising at least one sensor to sense if part (such as engine) is detached from aircraft.

In one preferred embodiment of the invention a pyrotechnic device is actuable on sensing part (engine) detachment and detonates an explosion to destroy or substantially destroy part

In another preferred embodiment of the invention a slowing device such as a parachute is employed to slow part

The part may be a wing nose tail landing gear (or part thereof) or other massive part

It is known to launch an aircraft missile mid-flight. A radar, tracking the missile position, informs persons on the ground of its location and therefore it can be deduced if the missile is launched (and has left the aircraft). Also a pilot can sometimes see the missile some time after launch when it flies into view.

Another aim is to provide a system which informs someone of part detachment.

According to a second aspect of the invention there is provided an aircraft comprising at least one sensor to sense if part not intended to detach from the aircraft during flight such as an engine is detached and a communication means which is actuable on sensing part detachment to provide a signal.

The signal may be communicated to cockpit and/or ground control and/or other aircraft in or to be in the vicinity.

Preferably the aircraft has an aircraft control system, the control system comprising a GPS system having stored exclusion zone/borer based on based on GPS information and/or altitude measurements, the signal being cooperable with aircraft control system to determine if aircraft or part is in a no go zone, and if so means to generate a further control signal.

The further control signal may give rise to destruction of the aircraft or part.

The sensor may measure the distance between said part and aircraft . For the aircraft itself the altimeter can measure the rate of descent and if the rate is around terminal velocity (calculated minusing the weight of detached part) (i.e. out of control on a dive or fall) a pyrotechnic device is employed to destroy aircraft.

In one embodiment of the invention RF tags on the part and/or the aircraft sense and communicate distance s and/or other data. The RF tags may be slender so as not to impair aerodynamics and to be less bulky.

The tags ay be embedded in the lay up of the fairing of the part or aircraft (where it has fairing)

Alternative or additionally sensor may be a suitable stress or load sensor, for example

sensor may be located on a second part of the aircraft adjacent the said part of the aircraft

The part can break from the aircraft at a number of failure points. preferably a plurality of sensors are provided corresponding to said number of points. In that way wherever the break occurs failure can be deduced

One reason an engine can fall from a aircraft is that if fastening bolts loosen it is unsupported.

An aim is to provide a housing for an engine which is failure proof from mechanical fastening parts loosening and therefore cannot permit an engine to fall from it.

According to a third aspect of the invention there is provided an aircraft wing , the wing having a bifurcated structural section which defines an opening, the opening being intended to house an engine.

Preferably the engine is fitted therein and structural members are fitted to partially "envelope" the engine in place. Obviously this has implications in servicing the engine as periodic welding is necessary to retrieve engine but this is acceptable (since major servicing is not very often) to achieve the desired safety aim.

According to a fourth aspect of the invention there is provided an aircraft having a pair of aircraft wings in accordance with the fourth aspect.

An aircraft in accordance with the invention will now be described by example and with reference to the accompanying drawings, in which

figure 1 is a schematic plan view of an aircraft in accordance with the invention,

figure 2 is a schematic side view of the aircraft,

figure 3 is another side view showing a later moment during flight or other movement for example on the runway,

figure 4 is a schematic plan view of a wing in accordance with the invention,

figure 5 is a schematic front view of the wing, and

figure 6 is a cutaway in plan of the wing.

Referring to figs 1 to 3, an aircraft such as a fixed wing aircraft comprises a fuselage 10, a pair of wings 12, a tailplane 14, and a rudder 16. Engines 18 are arranged on the wings 12 in known fashion. Other parts of a typical aircraft such as a landing gear, cockpit details, etc. are omitted for clarity.

Referring to figs 2 and 3, a transponder and receiver pair 19a, 19b is arranged in (or on) the wings 12 and the engines 18. The transponder 19a signal is typically coded for ID purposes.

A GPS system and an altimeter measure the positions of the transponder and receiver pair 19a, 19b in the wings 12 and the engines 18 periodically or continuously.

The transponder 19a signal sends a signal to the receiver indicating the positions of the wings 12 relative to the engines 18.

If the engine 18 breaks from the wing 12, the sensed positions of the transponder and receiver pair 19a, 19b will change accordingly. If the receiver pair 19b receives a signal indicating that the engine has broken from the wing, a signal x is generated for further aircraft control.

Referring to Figures 4 and 5, a wing 20 comprises structure 24 and fairing 26 laid-up on it. The structure 24 and fairing 26 bifurcates along the wing 20 to define an opening. An engine 22 is housed in the opening.

Referring to figure 6, it will be noted that the generally cylindrical engine 22 is enveloped by the structure 24 having a lip 24a. The fairing 26 typically extends to overlap the lip 24a. In maintenance it necessary to cut through fairing etc., but the safety benefits that the engine cannot fall off of the wing obviously outweigh that. In any event non-destructive testing helps in this regard as it ended unnecessarily accessing the engine to check it for faultiness.

Any kind of communication and sensing equipment can be utilised as long as provision is taken to ensure that important aircraft signals are not interfered with.

The invention can easily apply to other parts of the aircraft (including those not shown).

claims

1. an aircraft comprising a part not intended to detach from the aircraft during flight such as an engine, the aircraft also comprising at least one sensor to sense if part (such as engine) is detached from aircraft.

2. an aircraft according to claim 1, wherein the aircraft comprises a pyrotechnic device which is actuable on sensing part (engine) detachment and detonates an explosion to destroy or substantially destroy part

3. an aircraft according to claim 1, wherein the aircraft comprises a slowing device to slow part

4. an aircraft according to claim 3, wherein the slowing device comprises a parachute

5. an aircraft according to any preceding claim, wherein the part is a relatively massive part such as a wing, nose, tail, landing gear.

6. an aircraft comprising at least one sensor to sense if part not intended to detach from the aircraft during flight such as an engine is detached and a communication means which is actuable on sensing part detachment to provide a signal.

7. an aircraft according to claim 6, wherein the signal is communicated to cockpit and/or ground control and/or other aircraft in or to be in the vicinity.

8. an aircraft according to claim 6 or 7, wherein the aircraft has an aircraft control system, the control system comprising a GPS system having stored exclusion zone/borer based on based on GPS information and/or altitude measurements, the signal being cooperable with aircraft control system to determine if aircraft or part is in a no go zone, and if so means to generate a further control signal.

9. an aircraft according to claim 6 or 7 or 8, wherein the further control signal gives rise to destruction of the aircraft or part.

10. an aircraft according to any of claims 6 to 9, wherein the sensor measures the distan.. between said part and aircraft .

11. an aircraft according to claim 10, wherein for the aircraft itself the altimeter can measure the rate of descent and if the rate is around terminal velocity (calculated minusing the weight of detached part) (i.e. out of control on a dive or fall) a pyrotechnic device is employed to destroy aircraft.

12. an aircraft according to any preceding claim, wherein the sensor comprises RF tags on the part and/or the aircraft which sense and communicate distances and/or other data.

13. an aircraft according to claim 12, wherein the RF tags are slender so as not to be positioned on aircraft without substantially impairing aerodynamics and to be less bulky.

14. an aircraft according to claim 12 or 13, wherein the tags are embedded in the lay up of the fairing of the part or aircraft (where it has fairing)

15. an aircraft according to any preceding claim, wherein the sensor comprises a suitable stress or load sensor, for example

16. an aircraft according to any preceding claim, wherein sensor is located on a second part of the aircraft adjacent the said part of the aircraft

17. an aircraft according to any preceding claim, wherein a plurality of sensors are provided corresponding to a plurality of potential failure points.

18. an aircraft wing , the wing having a bifurcated structural section which defines an opening, the opening being intended to house an engine.

19. an aircraft wing according to claim 18, wherein the engine is fitted therein and structural members are fitted to partially "envelope" the engine in place.

20. an aircraft having a pair of aircraft wings in accordance with claim 18 or 19.

21. An aircraft substantially as described herein and with reference to the accompanying drawings.

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Application No:	GB 0128020.5	**Examiner:**	Terence Newhouse
Claims searched:	1 and 6 at least	**Date of search:**	2 May 2002

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.T): B7G(G3BX,G3X); B7W(WRHC,WRHX,WRX)

Int Cl (Ed.7): B64B; B64C; B64D; B64F; B64G

Other: ONLINE: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X,Y	GB 0890416 A	(PHILIPS), see claim 1 and fig 1 noting radio transmitters 1-7 distributed around aircraft which will transmit if a part they are attached to breaks off	X:1,6,7, 12,17 Y:3,4
Y	US 5009374	(MANFREDI et al), see for example column 4 lines 16-32 noting use of parachute on detached parts	3,4
X,Y	JP 8-188200 A	(TOSHIBA), see also WPI and PAJ abstracts and figures noting detachment sensor 10 of part 7	X:1,5-7, 16,17 Y:3,4

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.